Midterm results of the surgical treatment of varices by phlebectomy with conservation of a refluxing saphenous vein

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Background: **A new physiopathologic concept within superficial venous insufficiency (SVI) describes ascending progression from the collaterals to the saphenous veins (SV), leading to a treatment that aims to remove the varicose reservoir and not the SVs. This study reports the midterm results of this therapeutic approach.**
Methods: **This is a retrospective study of patients treated for varices by phlebectomy with conservation of a refluxing SV before July 2004. We evaluated the varicose reservoir by determining the number of zones to be treated (NZT); each lower limb was divided into 32 zones in the preoperative mapping. We performed a clinical and duplex ultrasound examination after 6 months and 1 year, and then once a year until year 4.**
Results: **Amongst 811 lower limbs operated on for first-time varicose veins, 303 in 221 patients (55 men; 166 women), mean age, 52.7 years (range, 20-93 years), were treated by phlebectomy, with conservation of a refluxing SV. All lower limbs operated on presented preoperative SV reflux >0.5 seconds: great SV (GSV), 85.8%; small SV (SSV), 11.9%; and GSV and SSV, 2.3%. The average NZT was 6.05 (range, 2-10). SV reflux was reduced to < 0.5 seconds in 69.6%, 69.2%, 68.7%, 68.0%, and 66.3% of limbs, respectively, after 6 months, 1, 2, 3, and 4 years of follow-up. Symptoms improved or disappeared in 84.2%, 84.2%, 83.4%, 81.4%, and 78.0% of limbs at each annual check-up until year 4. Freedom of varices recurrence was 95.5%, 94.6%, 91.5%, and 88.5%, respectively at 1, 2, 3, and 4 years. When the NZT was >7, the postoperative varicose recurrence was more frequent (odds ratio, 6.82; $P = .0001$), and the postoperative elimination of SV reflux was more frequent (odds ratio, 4; $P = .037$) as was symptoms improvement (odds ratio, 2.91; $P = .004$). When an ostiotruncal SV reflux extended to the malleolus preoperatively, the elimination of the SV reflux was less frequent (47.6% vs 70.3%; $P < .05$).**
Conclusion: **Ablation of the varicose reservoir with conservation of a refluxing SV can be an effective treatment in the midterm for the signs and symptoms of SVI and leads to nonsignificant SV reflux in more than two of three cases. The extent of the varicose reservoir ablation is the key factor determining the hemodynamic and clinical efficacy of this more limited surgical approach. (J Vasc Surg 2009;50:107-18.)**

The traditional physiopathologic concept of primary varicose disease is based on a hypothesis of retrograde hemodynamic evolution of superficial venous insufficiency, which describes a development of the reflux from connections between the deep venous system and the superficial venous system, particularly in the region of the confluence with the saphenous veins (SVs). According to this theory, the occurrence of a reflux in the region of the terminal valve of the SV is the key point in the evolution, with the reflux extending gradually in a retrograde fashion or descending along the SV, ultimately reaching the suprafascial collateral veins on which the varices develop. This description was disseminated as early as 1890 by Trendelenburg[1] and was repeated much later in a more accurate manner by Ludbrook.[2]

This description was also challenged regularly by studies describing the presence of varices that were not necessarily accompanied by SV incompetence.[3-11] Nevertheless, the Trendelenburg theory remained very widely dominant, having as a consequence the dogma of the elimination of the SV and of all of the points of reflux, starting with the deep veins (including, in particular, in the region of the saphenous confluence), by high ligation at the deep vein level, in accordance with the principles described by Mayo[12] and Babcock[13] at the start of the 20th century.

The advent of endovenous SV ablation techniques by radiofrequency (RFA) or laser (EVLA) did not modify the descending physiopathologic concept, because these techniques apply the same therapeutic principle as the traditional surgery, with the only difference consisting of the absence of high ligation at the saphenous confluence. Paradoxically, the good midterm results of the endovenous techniques, despite the absence of the direct obliteration of the ostial reflux by high ligation,[14-16] led to renewed questions regarding the relevance of the descending hemodynamic concept.

These questions were supported by studies, including many earlier ones, based on better hemodynamic knowledge, thanks to the progress of ultrasound examinations.[5-11] Certain publications also suggested the hypothesis of a so-called ascending or multifocal development of varicose disease starting from the distal superficial venous network.[6,7,9-11,17,18] Thus, the minimally invasive surgical

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Competition of interest: none.
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0741-5214/$36.00

doi:10.1016/j.jvs.2008.12.067

approach focusing on the treatment of the varicose reservoir by phlebectomy, as described by Muller,[19] is enjoying renewed attention, including with the conservation of a refluxing SV.[20] We describe here our midterm clinical and hemodynamic experience with this more limited surgical approach.

MATERIALS AND METHODS

This retrospective study was conducted at two surgical centers (Riviera Vein Institute in Nice, and Charcot Clinic in Lyon). Two surgeons participated in the study, one at each facility (P. P. in Nice and B. R. in Lyon).

Preoperative data. The preoperative data for the patients who underwent operations consecutively for the first time for varices between May 2003 and July 2004 were reviewed, in terms of age, sex, CEAP class C, the presence of symptoms (pain, heaviness, a swelling sensation, pruritus, night cramps, restlessness, tingling, heat) regardless of their location on the limb, and their repercussions according to the Venous Disability Score[21]: 0 for "asymptomatic"; 1 for "symptomatic but able to perform normal activities without compressive therapy"; 2 for "can perform normal activities only with compression and/or limb elevation"; 3 for "unable to perform normal activities even with compression and/or limb elevation."

The hemodynamic and anatomic data were recorded with duplex ultrasound (DUS) examination performed with the patient standing upright: the reflux was evaluated by DUS scanning of both the great (GSV) and small SV (SSV), using the manual venous flushing maneuver in the calf region, and the diameter of the SV was measured by DUS in the saphenous confluence region. The reflux in the SV was recorded at the moment of the sudden release of manual compression of the calf. Under these conditions, a reflux was considered to be pathologic if the reflux duration was >0.5 seconds for the superficial veins and 1 second for the deep veins. The reflux duration was measured with 0.1-second accuracy. The measurement was repeated twice by the same operator in both facilities (R. B. in Nice and Lyon). A mean was calculated for the reflux duration measurements.

The extent of the varicose reservoir was evaluated according to the number of zones to be treated (NZT) by phlebectomy, with each limb divided into 32 zones in the preoperative clinical mapping (Fig 1). Each limb was divided into four surface areas (anterior, posterior, lateral, and medial), and then each surface area was divided in eight zones: the thigh into three zones (the upper third, middle third, and lower third), the calf into three zones (the upper third, middle third, and lower third), plus one zone for the knee and one zone for the foot. This arrangement reflects our clinical examination technique, in which we examine each lower limb in a standing position, from the front, from the back, and from each of its profiles (medial and lateral).

Surgical procedure. The decision to preserve the SV was made subjectively by the surgeon for patients who appeared to be at a less advanced stage of the SV disease, both hemodynamically (eg, with a continent ostial valve and partial SV reflux) as well as clinically (eg, with an absence of symptoms or trophic disorders).

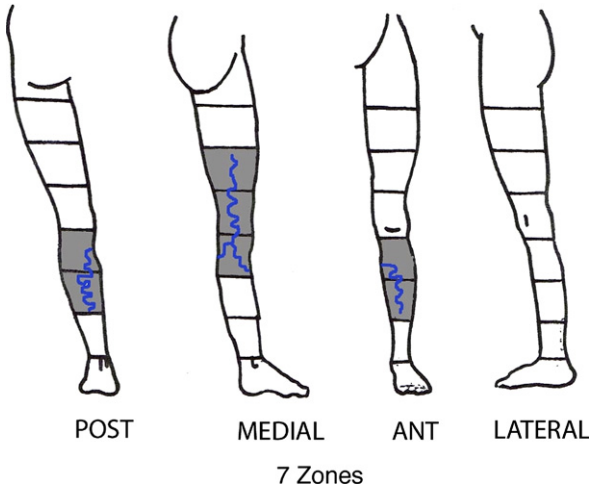


Fig 1. Preoperative clinical mapping shows the limb divided in 32 zones. Example shows seven zones to be treated for varices.

The cost of the procedures was calculated according to the reimbursement of medical fees and hospitalization expenses by the insurance companies.

Follow-up. As specified by the protocol of follow-up usually used in the two centers involved in this study, the patients were seen postoperatively at 1 month and 6 months, and then once a year for the following evaluations:

- SV by DUS, according to the same methods used in the preoperative examination. Reflux was deemed nonsignificant if the reflux duration was <0.5 seconds; considerably reduced if the postoperative reflux duration was reduced by >50% compared with the preoperative reflux duration, and unchanged in the other cases.
- CEAP class C according to the clinical examination; the presence of recurrent varicose veins included the Recurrent Varices After Surgery (REVAS) criteria[22] (ie, the presence of visible or palpable varices >3 mm in a limb that had previously undergone an operation).
- Evolution of the symptoms that were experienced, according to the patient questionnaire (relief, unchanged or worse) and according to the Venous Disability Score.
- Evolution of esthetics, according to the patient questionnaire (improved, unchanged or worse).

Statistical analysis. The means for continuous variables were calculated with a standard deviation of .05 at the α threshold. The qualitative bivariate comparisons used the χ^2 test, and the means comparisons used the t test. Midterm survival was determined using Kaplan-Meier life-table analysis. The observation of linear link between the NZT and the other qualitative variables was assessed using the linear trend χ^2 test (extended Mantel-Haenszel χ^2 test). Statistical analysis was performed using Epi Info (Centers

Table I. Cohorts operated on by ambulatory selective varices ablation under local anesthesia[a] compared with high ligation and stripping

Variable[b]	*ASVAL*	*HLS*	P
Limbs, No.	303	270	
Patients, No.	221	230	
Age, y	52.7 ± 1.55 (20-83)	54.5 ± 1.66 (20-86)	.002
Female, %	75.1	65.20	<.05
BMI	23.8 ± 0.44	25.2 ± 0.51	.0006
CEAP classification, %			
C_0-C_1	0	0.80	
C_2	85.80	76.6	<.05
C_3	5.30	4.90	
C_4	8.90	15.	<.05
C_5-C_6	0	2.10	
NZT	6.05 ± 0.15	7.19 ± 0.21	<.00001
Asymptomatic limbs, %	33.7	21.5	<.05
VDS for LSBS	1.30 ± .08	1.32 ± 0.08	.68
Saphenous reflux, %			
GSV	88.10	80.70	
SSV	11.90	17.80	<.05
GSV + SSV	0	1.50	
Saphenous confluence			
Competence, %	15.80	7.80	<.05
Diameter, mm	7.05 ± 0.27	8.40 ± 0.31	<.0001
Whole SV reflux, %[c]	8.60	44.40	<.05

ASVAL, Ambulatory selective varices ablation under local anesthesia*; BMI,* Body mass index; *GSV,* great saphenous vein; *HLS,* high ligation and stripping; *LSBS,* limbs symptomatic before surgery; *NZT,* number of zones to be treated; *SSV,* small saphenous vein; *SV,* saphenous vein; *VDS,* Venous Disability Score.
[a]Phlebectomy with preservation of a refluxing saphenous vein.
[b]Continuous data are presented with the standard deviation (range), if applicable.
[c]From the confluence to the malleolus.

for Disease Control and Prevention, Atlanta, Ga) and XLSTAT software (Addinsoft France, Paris, France). The significance level for all of the comparisons was set at $P < .05$.

RESULTS

Population. From May 2004 to July 2005, 811 lower limbs in 599 patients (444 women; 155 men) underwent consecutive operations for the first time on varices. Patients were a mean age of 53.10 ± 0.96 years (range, 20-86 years). Of these 811 lower limbs, 573 (70.7%) presented reflux along at least one saphenous axis (485 GSV; 84 SSV; 4 GSV and SSV), whereas 238 (29.3%) had isolated varices with no saphenous reflux. No deep venous refluxes were diagnosed.

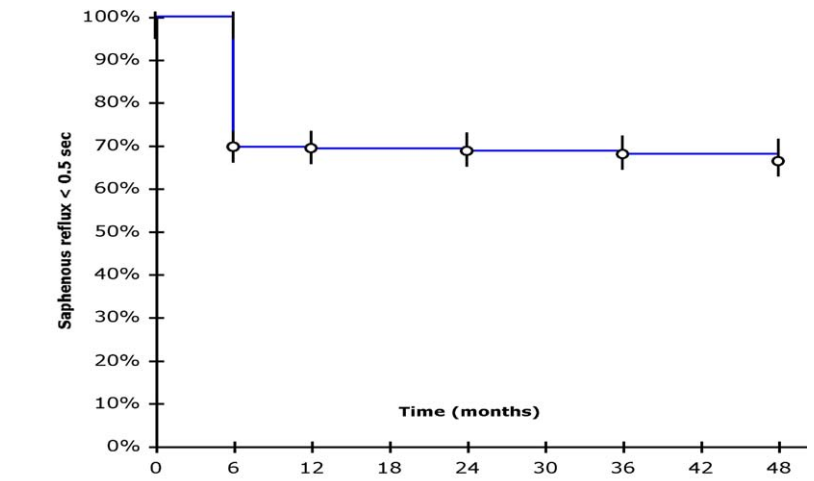
In the 573 lower limbs with SV reflux, ablation of varicosities with conservation of a preoperatively refluxing SV, so-called ambulatory selective varices ablation under local anesthesia (ASVAL) was performed 303 times (52.9%), whereas high ligation associated with stripping (HLS) of the SV was performed in the other 270 cases (47.1%). No RFA or EVLA treatments were performed during the study period.

The comparison of the cohorts undergoing ASVAL and HLS revealed significant differences (Table I): In the ASVAL group the mean age was younger, the proportion of women was greater, the mean body mass index (BMI) was lower, the CEAP C_4 to C_6 class was less frequent, the mean varicose reservoir was smaller (the mean NZT was lower), and the incidence of asymptomatic lower limbs was higher; however, the mean Venous Disability Score was equal for symptomatic limbs in both groups. The hemodynamic status of the lower limbs undergoing ASVAL also revealed significant differences: the saphenous confluence was continent more often, its diameter was smaller, and the saphenous reflux was less often complete from the ostium to the malleolus.

The calculation of the cost of the procedures reimbursed by the insurance companies was €229,334.64 for the ASVAL group, which was a significant savings compared with €337,468.20 for the HLS group. The mean cost for each procedure was €758.88 ± 10.20 for ASVAL vs €1143.96 ± 12.42 for HLS ($P < .05$), yielding a mean saving of €387.08 ± 14.35 per procedure for the ASVAL group.

We chose to include in the retrospective study only the patients who underwent ASVAL, with an analysis of the operating protocol and postoperative progress. Our intent was to report the results obtained by the patients treated with ablation of the varices and conservation of the refluxing SV. Furthermore, we determined that the significant demographic and clinical differences between the ASVAL and HLS groups represented a major bias for the comparison of the results obtained in the two groups.

Operation and postoperative follow-up. The ASVAL was done with phlebectomies through staged incisions under tumescent local anesthesia (150 mg of lidocaine with 75 μg of epinephrine for each 500 mL of isotonic bicar-



At risk	303	280	176	118	99	40
Failing		65	1	1	1	1
Censored		19	57	18	58	39
Survival %		69.6	69.2	68.7	68.0	66.3
Standard error		.027	.028	.028	.029	.033

Fig 2. Kaplan-Meier analysis shows the presence of nonsignificant saphenous reflux (reflux duration <0.5 seconds) after ambulatory selective varices ablation under local anesthesia. *Error bars* represent 95% confidence intervals at each time point.

bonate). No additional preoperative sclerotherapy, and no RFA or EVLA, was performed for the treatment of varicosities. The 303 lower limbs were treated by ASVAL over the course of 288 operations. All operations were on an outpatient basis. The mean duration was 51.80 ± 1.77 minutes (range, 20-90 minutes), and the mean number of incisions was 31.10 ± 1.33 (range, 15-77). Tumescent local anesthesia was used for all operations. Postoperative anticoagulant treatment by heparin therapy was administered in two patients (0.7%) as a change from long-term oral anticoagulation treatment.

All of the lower limbs operated on by ASVAL were reviewed during the first postoperative consultation at day 8, and postoperative thrombosis of the GSV was observed in three patients (1%). In two patients the GSV presented a preoperative segmental dilatation >10 mm (11 and 15 mm), and in one patient the GSV presented a preoperative major difference in diameter (>10 mm) on both sides of the resected varicose collateral vein. One patient was treated by high ligation to avoid the extension of a thrombus in the femoral vein, and the other two patients were treated medically with heparin therapy. No other postoperative complications were observed.

A total of 280 lower limbs (92.4%) were seen again beyond the first month postoperatively, with a mean follow-up duration of 32.4 months (range, 3-48; median, 35.4 months).

Hemodynamic and anatomic evolution. Reflux was not significant in the SV (reflux duration <0.5 seconds) after 6 months and after 1, 2, 3, and 4 years by life-table analysis in 69.6%, 69.2%, 68.7%, 68.0%, and 66.3% of limbs, respectively (Fig 2). The saphenous reflux was dramatically reduced (reflux duration <0.5 seconds, or postoperatively <50% preoperatively) in 92.1%, 92.1%, 92.1%, 91.6%, and 90.7% of limbs, at 6 months and after 1, 2, 3 and 4 years by life-table analysis (Fig 3).

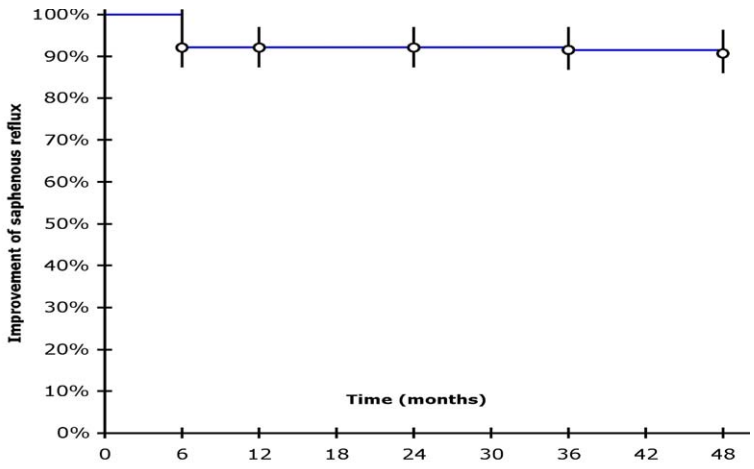
The diameter of the SV significantly decreased, as measured at the saphenous confluence, in 243 lower limbs after 6 months (5.87 ± 0.23 mm vs 7.87 ± 0.25 mm preoperatively; $P < .0001$), and the magnitude of this reduction was correlated with the improvement in the hemodynamics of the SV (Table II).

Evolution of signs and symptoms. The proportion of the 171 limbs symptomatic before surgery and that were tracked with a symptoms relief was 84.2%, 84.2%, 83.4%, 81.4%, and 78.0%, respectively, at 6 months, and at 1, 2, 3, and 4 years by life-table analysis (Fig 4). The mean Venous Disability Score was significantly lower at month 6 postoperatively for the symptomatic limbs (0.64 ± 0.08 vs 1.30 ± 0.08 preoperatively; $P < .001$), and remained so throughout the follow-up period until the year 4: 0.63 ± 0.08 at 1 year, 0.64 ± 0.09 at 2 years, 0.69 ± 0.09 at 3 years, and 0.68 ± 0.11 at 4 years.

An esthetic improvement was asserted by 93.9% of patients at 6 months and by 93.2%, 92.7%, 91.6% and 89.9% at 1, 2, 3, and 4 years by life-table analysis (Fig 5).

Freedom of varices recurrence in the treated lower limbs at 6 months and at 1, 2, 3, and 4 years after life table analysis was 98.9%, 95.5%, 94.6%, 91.5%, and 88.5%, respectively (Fig 6).

Among the 24 lower limbs that presented a varicose recurrence during the follow-up according to the REVAS[22]



At risk	303	280	239	181	162	103
Failing		22	0	0	1	1
Censored		19	58	19	58	102
Survival %		92.1			91.6	90.7
Standard error		.016			.017	.019

Fig 3. Kaplan-Meier analysis shows for presence of dramatically reduced saphenous reflux (reflux duration <0.5 seconds or postoperative reflux duration <50% preoperative reflux duration) after ambulatory selective varices ablation under local anesthesia. *Error bars* represent 95% confidence intervals at each time point.

Table II. Evolution of the diameter of the saphenous confluence after ambulatory selective varices ablation under local anesthesia[a]

Variable	*No.*	*Mean SC diameter, mm*		*Reduction, %*	P
		Pre-op	*Post-op (6-mon)*		
Whole cohort controlled	243	7.87 ± 0.25	5.87 ± 0.23	25	<.0001
Unchanged SR[b]	19	9.56 ± 1.10	8.26 ± 1.13	13.5	<.0001
Considerably reduced SR[c]	63	6.56 ± 0.39	5.06 ± 0.33	22.7	<.0001
Reflux duration <0.5 s	161	8.18 ± 0.23	5.64 ± 0.23	31.7	<.0001

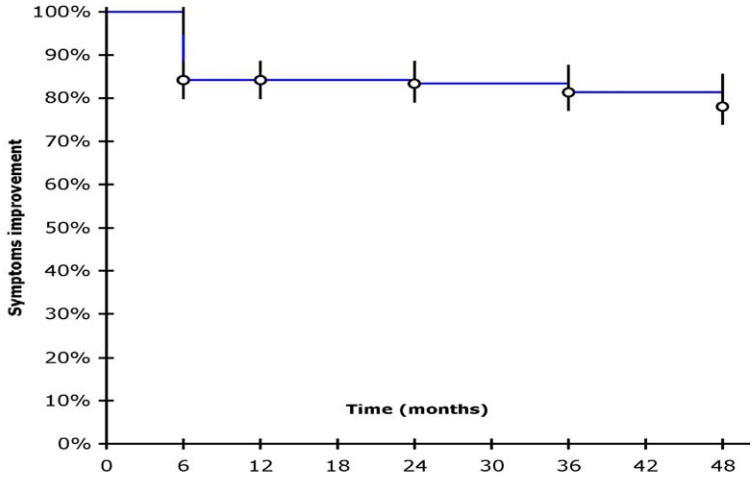
SC, Saphenous confluence; *SR,* saphenous reflux.
[a]Phlebectomy with preservation of a refluxing saphenous vein.
[b]Postoperative reflux duration ≥50% preoperative reflux duration.
[c]Postoperative reflux duration <50% preoperative reflux duration.

definition, there was an unchanged reflux of the SV compared with the preoperative situation in three limbs. The reflux was considerably reduced (postoperative <50% preoperative) in four limbs, whereas no reflux was noted (reflux duration <0.5 seconds) in 17. An incompetent perforator vein with a significant reflux (>0.5 seconds) and with a diameter of >3 mm was present in three of the 17 limbs with localized recurrent varices. No indications of neovascularization were detected by the Doppler echographic examination of the recurrence zones, all of which affected the degradation of other collateral vessels. Furthermore, no deep venous reflux was observed in the lower limbs that exhibited a recurrence.

Additional procedures during the follow-up. Freedom of a secondary major procedure (surgical procedure or echo-guided foam sclerotherapy) after life-table analysis was 98.2%, 97.1%, 97.1%, 97.1%, 89.8%, respectively, at 6 months, and at 1, 2, 3, and 4 years (Fig 7). A major additional procedure was performed in 10 limbs during the follow-up period:

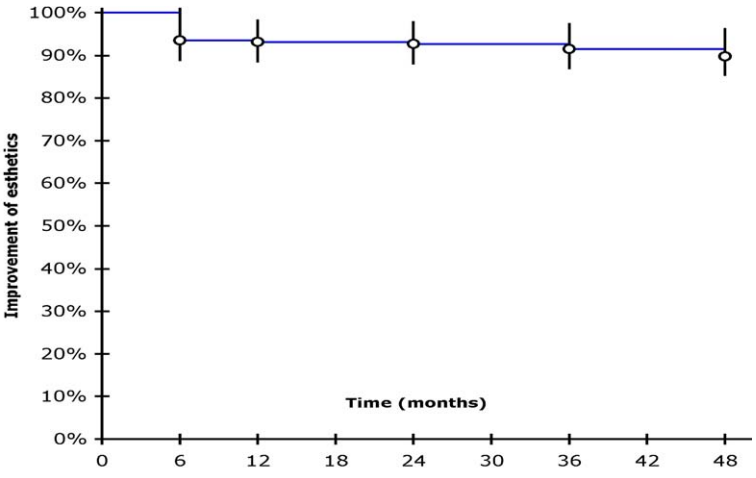
- Three limbs required the suppression of a SV in which the reflux was unchanged compared with preoperatively. In one limb this was by echo-guided foam sclerotherapy of the GSV due to the persistence of symptomatic reflux with no varicose recurrence. Two limbs underwent HLS of the SSV, after 6 and 18 months, due to symptomatic varicose recurrence.
- In seven, the procedure was limited to a new phlebectomy for cosmetic reasons after 12, 18, 20, 24, 28, 30, and 36 months, due to an asymptomatic varicose recurrence.

In 14 of 24 limbs with recurrence, no additional procedure was performed because of the very limited nature of



At risk	303	171	141	98	86	48
Failing		27	0	1	2	2
Censored		3	43	11	36	46
Survival %		84.2		83.4	81.4	78.0
Standard error		.028		.029	.031	.038

Fig 4. Kaplan-Meier analysis shows for symptoms relief after ambulatory selective varices ablation under local anesthesia. *Error bars* represent 95% confidence intervals at each time point.



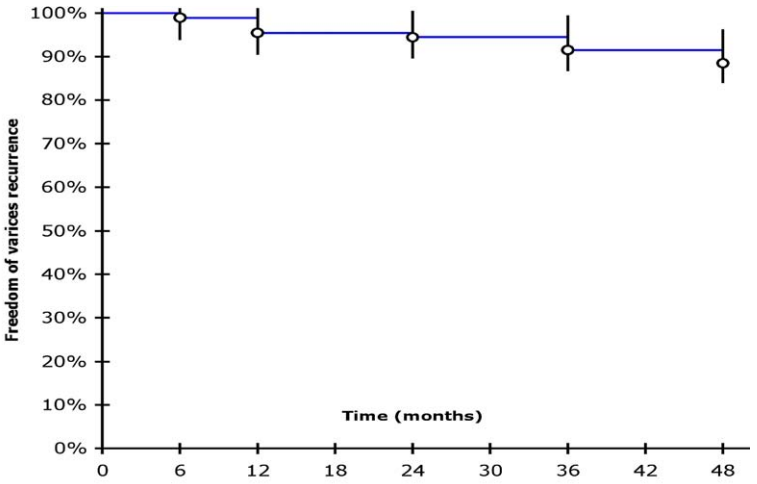
At risk	303	280	243	185	166	107
Failing		18	1	1	2	2
Censored		19	57	18	57	105
Survival %		93.6	93.2	92.7	91.6	89.9
Standard error		.015	.015	.016	.017	.021

Fig 5. Kaplan-Meier analysis shows for esthetic improvement after ambulatory selective varices ablation under local anesthesia. *Error bars* represent 95% confidence intervals at each time point.

varices, which did not entail any discomfort or inconvenience for the patient.

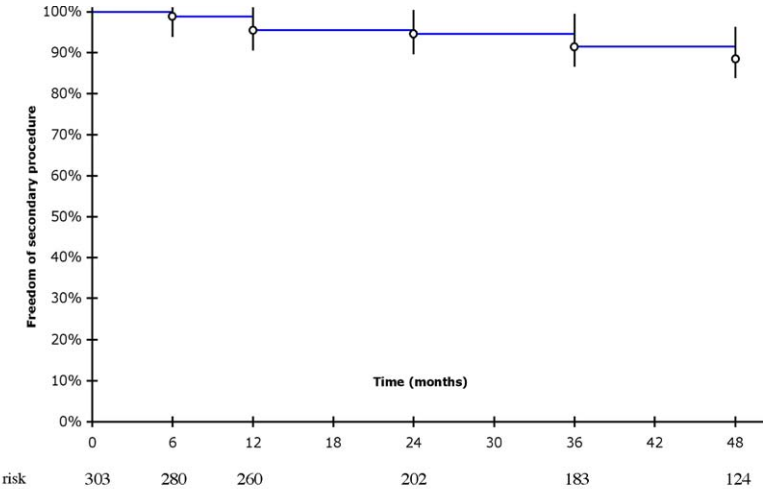
None of the 179 limbs in which reflux became nonsignificant (reflux duration <0.5 seconds) as of the first postoperative examination (performed 6 months after the procedure) exhibited recurrent SV reflux during the follow-up period. However, clinical recurrence did appear in 17 limbs in this cohort. This was treated with phlebectomy in five and was not treated surgically in 12 (Table III).

After stratification of variables, we found a significant link between the NZT and the postoperative evolution of



At risk	303	280	260	202	183	124
Failing		3	9	2	6	4
Censored		17	49	17	53	120
Survival %		98.9	95.5	94.6	91.5	88.5
Standard error		.006	.013	.014	.019	.023

Fig 6. Kaplan-Meier analysis shows for freedom of recurrence of varices after ambulatory selective varices ablation under local anesthesia. *Error bars* represent 95% confidence intervals at each time point.



At risk	303	280	260	202	183	124
Failing		3	9	2	6	4
Censored		17	49	17	53	120
Survival %		98.9	95.5	94.6	91.5	88.5
Standard error		.006	.013	.014	.019	.023

Fig 7. Kaplan-Meier analysis shows for secondary major intervention (surgical procedure or foam echo-guided sclerotherapy) after ambulatory selective varices ablation under local anesthesia. Error bars represent 95% confidence intervals at each time point.

saphenous reflux, existence of symptoms relief, and emergence of varices recurrence:

A significant linear trend was observed between the absence of saphenous reflux in postoperative course and higher NZT ($P = .037$): NZT ≤4, odds ratio (OR), 1; NZT 5, OR, 0; NZT 6, OR, 9.82; NZT 7, OR, 3.67; NZT >7, OR, 6.81 (Table IV).

A significant linear trend was observed between the symptoms relief ($P = .004$) and higher NZT: NZT ≤4, OR,

Table III. Follow-up of the 179 limbs for which the saphenous reflux was nonsignificant (reflux duration <0.5 seconds) at the first postoperative control (6 months) after ambulatory selective varices ablation under local anesthesia[a]

Variable	*6 mon*	*1 y*	*2 yrs*	*3 yrs*	*4 yrs*
No. at risk	179	177	134	123	84
Saphenous reflux recurrence	0	0	0	0	0
Varices recurrence	0	1	6	6	4
Redo surgery	0	0	0	2	3

[a]Phlebectomy with preservation of a refluxing saphenous vein.

Table IV. Linear trend between number of treated zones and nonsignificant saphenous reflux (reflux duration <0.5 seconds) after stratification of variable (extended Mantel-Haenszel χ^2 test)[a]

A, Recurrence of varices

Stratum 1

NZT	*Exposure level*	*Cases*	*Control*	*Total*	*Odds of exp*	*OR*
≤4	0	17	33	50	0.02	1
5	1	20	27	47	0	0
6	2	16	50	66	.2	9.82
7	3	28	39	67	.08	3.97
>7	4	6	44	50	.14	6.82
	Total	87	193	280		

B, Mantel-Haenszel summary OR and crude OR for each exposure level

Exposure	*Summary OR*	*Crude OR*
Level 0 vs		
Level 0	1	1
Level 1	0	0
Level 2	9.821	9.821
Level 3	3.968	3.968
Level 4	6.818	6.818

NZT, Number of zones to treated per limb; *OR*, odds ratio.
[a]Extended Mantel-Haenszel χ^2 for linear trend, 4.33; P_{1df} = .03752.

1; NZT 5, OR, 0.27; NZT 6, OR, 1.59; NZT 7, OR, 1.4; NZT >7, OR, 2.91 (Table V).

A significant linear trend was observed between the emergence of varices recurrence (P = .0001) and higher NZT: NZT ≤4, OR, 1; NZT 5, OR, 0.736; NZT 6, OR, 1.739; NZT 7, OR, 2.826; NZT >7, OR, 4 (Table VI).

Last, when an ostiotruncal saphenous reflux extending to the malleolus was assessed preoperatively, the presence of a postoperative nonsignificant SV reflux was less frequent (47.60% vs 70.30%; P < .05).

DISCUSSION

In this study, the comparison of the patients undergoing ASVAL with those undergoing HLS during the same period clearly favors more limited treatment that preserves the SV of the patients with a less evolved varicose disease. This confirms the subjective decision to conserve the SV, because we did indeed reserve the ASVAL procedure, ap-

Table V. Linear trend between number of zones treated and symptoms relief after stratification of variable (extended Mantel-Haenszel χ^2 test)[a]

A, Symptoms improvement

Stratum 1

NZT	*Exposure level*	*Cases*	*Control*	*Total*	*Odds of exp*	*OR*
≤4	0	42	8	50	5.38	1
5	1	28	19	47	1.47	.27
6	2	60	6	66	8.57	1.59
7	3	60	7	67	7.5	1.4
>7	4	47	3	50	15.67	2.91
	Total	237	43	280		

B, Mantel-Haenszel summary and crude odds ratios for each exposure level

Exposure	*Summary OR*	*Crude OR*
Level 0 vs		
Level 0	1	1
Level 1	.274	.274
Level 2	1.595	1.595
Level 3	1.395	1.395
Level 4	2.915	2.915

NZT, Number of zones to be treated per limb; *OR*, odds ratio.
[a]Extended Mantel-Haenszel χ^2 linear trend, 7.96; P_{1df} = .004775.

Table VI. Significant linear trend between number of zones to be treated per limb and varices recurrence after stratification of variable (extended Mantel-Haenszel χ^2 test)[a]

A, Recurrence of varices

Stratum 1

NZT	*Exposure level*	*Cases*	*Control*	*Total*	*Odds of exp*	*OR*
≤4	0	33	17	50	1.83	1
5	1	27	20	47	1.35	.74
6	2	50	16	66	3.19	1.74
7	3	57	10	67	5.18	2.83
>7	4	44	6	50	7.33	4
	Total	211	69	280		

B, Mantel-Haenszel summary and crude odds ratios or each exposure level

Exposure	*Summary OR*	*Crude OR*
Level 0 vs		
Level 0	1	1
Level 1	.736	.736
Level 2	1.739	1.739
Level 3	2.826	2.826
Level 4	4	4

NZT, Number of zones to be treated per limb; *OR*, odds ratio.
[a]Extended Mantel-Haenszel χ^2 for linear trend, 14.22; P_{1df} = .0001624.

Table VII. Persistence of saphenous reflux and frequency of varices recurrence at midterm after endovenous ablation of the saphenous vein

First author	*Year*	*Procedure*	*Patients, No.*	*Follow-up, mon*	*Patients at end of follow-up, No.*	*Persistence of SR, %*	*Frequency of varices recurrence, %*
Merchant[14]	2005	RFA	1222	5	406	12.8%	27.4
Nicolini[16]	2005	RFA	330	3	68	12.0%	22.8
Creton[15]	2006	RFA	330	5	103	15.0%	27.0

RFA, Radiofrequency ablation.

plying it to young women at a less advanced clinical stage (more frequently asymptomatic C_2) and with less extensive SV reflux. The correlation between the extent of the saphenous reflux, age, and clinical stage is described in the literature[11,17,23] and supports the theory of the development of superficial venous insufficiency starting from the suprafascial venous network in an ascending or multifocal fashion.[5,6,9-11,17,18] Thus, it appeared logical for us to reserve a more limited surgical treatment for the least evolved stage of the varicose disease in hopes of obtaining clinical and hemodynamic reversibility.

We observed postoperative thrombosis of the GSV in three limbs in which there was a significant difference in the diameter of the GSV on both sides of the removed varicose collateral veins, or in which sacciform dilatations of the SV were present. Thrombosis probably occurred because of venous stasis in the cul-de-sac in the first situation or in the venous dilatation in the second situation. In such situations, consideration must be given to the risk of thrombosis, and preference should be given to ablation of the SV or, at the very least, to the prescription of anticoagulant treatment postoperatively in the form of low-molecular-weight heparin at a prophylactic dose during the immediate postoperative period (8 days).

Our results showed a major change in SV hemodynamics after phlebectomy, in as much as the saphenous reflux was not significant in more than two-thirds of the limbs after a mean follow-up of 32.4 months, with a significant reduction of the SV diameter. Symptoms were clearly improved in limbs for which symptoms were preoperatively present, with a relief in >78% of the limbs throughout the follow-up and a significant reduction in the Venous Disability Score. Other authors reported that simple phlebectomy could change the hemodynamics and the diameter of the SV[24-26] and could provide good clinical results.[19,27,28]

We previously reported the results obtained after a 7-month follow-up of the same cohort of patients who underwent an ASVAL operation. These results demonstrated the functional benefit in terms of the symptoms and the hemodynamic benefit in terms of the saphenous reflux.[20] The midterm follow-up of this cohort demonstrated that the hemodynamic and clinical results remained stable for the monitored group until year 4.

The hemodynamic results for our cohort can be compared with those of the ablative techniques (either endovenous or surgical) in terms of the persistence or recurrence of a major saphenous reflux; that is, 9.3% at 4 years after life-table analysis for ASVAL vs 15% to 24.5% for RFA[14-16] or EVLA[29] and 10% to 15% for HLS[30,31] after 3 or 4 years of follow-up, for a population in which the preoperative frequency of CEAP classification C_0 to C_3 was >80% (82.7%,[14] 83%,[15,16] 91%,[29] and 90.1%, in our experience). Similarly, the incidence of improvement in the symptoms at 4 years, as observed after ASVAL by life-table analysis (78%), is comparable to the incidence of improvement obtained after RF (80% to 90%)[14-16] or HLS (65% to 80%),[30,31] although the patient populations may not be comparable with our series.

Our study had a broad definition of recurrence because it included the REVAS criteria[22] (ie, the reappearance of varices in a treated lower limbs regardless of its location). This broad definition probably explains why only 10 of 24 of varicose recurrences required a supplemental procedure, because most did not entail any symptoms or any aesthetic drawbacks. This recurrence frequency of 11.5% at 4 years after life-table analysis can be compared with the frequency observed after HLS[30,31] (15% to 30%) or after RFA[14-16] (22% to 23%) after 3 or 4 years of follow-up. It is highly noteworthy that for our cohort the recurrences were accompanied by an absence of saphenous reflux in 17 of 24 cases, and that the reflux was unchanged compared with the preoperative situation in only three limbs. This outcome is comparable with the midterm results of RFA, in which approximately half of the recurrences appeared despite permanent obliteration of the SV[14-16] (Table VII). This finding suggests an evolution of the varicose recurrence from the suprafascial venous network, unrelated to any persistent or recurrent SV reflux, comparable with the primitive ascending or multifocal evolution described in the literature.[6,7,9-11,17,18] This ascending or multifocal physiopathologic theory, which challenges the descending evolution along the saphenous axis according to primary valvular insufficiency, is based on several observations:

- The frequency of varicose recurrences after surgical or endovenous ablation of the saphenous vein, which is from 25% after 5 years, according to Kostkas,[32] to 62% after 11 years, according to Winterborn,[33] despite properly performed stripping; from 22.8% at 3 years, according to Nicolini,[16] to 27.4% after 5 years, according to Merchant,[14] after endovenous RFA treatment, despite the obliteration of the SV in more than 83% of cases. Perrin[34] reported that in 63.7% of cases, there is more than one source of reflux when a poststripping

recurrence appears, and that in >45% of cases, the recurrence involves the saphenous confluence.

- The disappearance of ostial reflux after endovenous treatment, despite the absence of crossectomy, in 93.4% of cases, according to Min[35]; after EVLA treatment in 95.7% of cases, according to Proebstle[36]; and after RFA in 88.2% of cases, according to Merchant,[14] or in 90.9% of the latter cases, according to Pichot.[37]
- The reduction in saphenous reflux, which in our experience is no longer significant (<0.5 seconds) after phlebectomies in more than two-thirds of the limbs. This finding may be due to the reduction in the size of the saphenous vein (which, in this study, is significant in the region of the saphenous confluence), thereby making it possible to detect whether the values were leakproof.

Lurie[38] suggested the possibility of functional insufficiency of the saphenous valves in the absence of any anatomic lesions. The closing of the valves would be caused by the existing pressure in the valvular sinus, which pressure would increase in direct proportion to the velocity of the anterograde flow. If this velocity fails to reach a critical value that allows pressure to be obtained that is sufficient to close the valve, the valve will not close. This is why a reflux may be present that passes through healthy valves when a patient is in the decubitus position, because the velocity of the anterograde flow is slight. Because ablation of the varicose reservoir makes it possible to improve the saphenous hemodynamics, it may also make it possible to eliminate a functional valvular insufficiency by increasing the anterograde velocity.

Numerous biochemical and anatomopathologic studies suggest a parietal, rather than valvular, hypothesis for varicose disease.[39-41] According to this hypothesis, valvular insufficiency is caused by the dilatation of the vein. Anatomoclinical studies indicate that in the presence of varices, not only is the saphenous confluence continent in >50% of cases,[4,8] but, moreover, the SV is often partially or wholly continent.[10,11]

All of these observations collectively challenge the sole culpability of the SV in the initial development of saphenous-vein disease.

The midterm follow-up of our cohort treated by ASVAL made it possible to detect the central role played by the varicose reservoir with regard to postoperative evolution. We found a significant link between the NZT, improvement of symptoms (NZT >7; OR, 2.91; $P = .004$), and absence of postoperative SV reflux (NZT >7; OR, 4; $P = .037$), probably because the resection of a large varicose reservoir is more likely to improve symptoms and hemodynamics of the SV. Conversely, the lower limbs that underwent resection of an extended varicose reservoir were more frequently subject to the onset of a varicose recurrence (NZT >7; OR, 6.82; $P = .0001$), probably because this was the mark of evolving varicose disease. This means that lower limbs with an extended varicose reservoir should be followed up with more rigorous monitoring, regardless of the treatment administered.

Finally, when the SV reflux reaches the malleolus, an improvement in this reflux is less expected in accordance with the principle of the elimination of the aspiration effect because the option of treating an underlying varicose reservoir is no longer available. In our study, the presence of a preoperative saphenous reflux extending to the malleolus was significantly associated with the persistence of a significant SV reflux during the postoperative period (52.4% vs 29.7%; $P < .05$).

In the literature, the judgment criterion applied after a treatment for varices usually consists of the evolution of the SV reflux or the evolution of the symptomatology, but the evolution of the varicose reservoir is never taken into consideration. However, our results show that it appears to play a major role in the indication of the treatment and in postoperative evolution. Nevertheless, it should be noted that we do not currently have a reliable and valid criterion for the evaluation of varicose reservoir.

In contrast to our approach, certain other authors advocate a treatment limited to RFA[42] or EVLA,[43] which led to spontaneous regression of the varices in 28% to 65% of cases after the obliteration of the SV, with no intervention affecting the varicose reservoir, albeit with a short follow-up of 3 to 9 months, and with secondary treatment (foam sclerotherapy, phlebectomy, stripping) for residual varices in 17% to 62.5%. Thus, no conclusions can be offered regarding the mid- or long-term evolution of the SV disease after this type of treatment, which is limited to the saphenous axis.

No treatment can characterize itself as "radical" with regard to the treatment of varices, probably because the natural history of varicose disease differs from patient to patient, thereby calling into question the traditional descending physiopathologic dogma. Consequently, regardless of the treatment technique, it is logical to contemplate a long-term follow-up for the patients treated for varices, with the adaptation of the procedures and the choice of techniques on a case-by-case basis and with the abandonment of invariable and needlessly destructive treatments.[44-47] Within this context, the choice of a treatment limited to phlebectomy—even in the presence of saphenous reflux—may be the first-line treatment apart from the evolved stages because it is minimally invasive, focuses on the varicose reservoir, and respects the saphenous axis, whose recuperative potential—as our study has shown—is far from negligible. Preservation of the SV, whose physiologic role may perhaps have been discounted, should be an important factor in the long-term management of varicose disease.

CONCLUSIONS

The performance of isolated phlebectomy with the conservation of a refluxing SV may be effective over the midterm against the symptoms of superficial venous insufficiency, for the disappearance of the varices, and for saphenous hemodynamics, with a nonsignificant postoperative

reflux in two-thirds of limbs. The magnitude of the volume of the varicose reservoir appears to be the determining factor for the clinical and hemodynamic efficacy of this more limited surgical approach. Further studies—including, in particular, prospective studies—will be necessary to obtain clearer definition of the indications for this therapeutic approach, to evaluate the SV with regard to long-term evolution, and to identify a reliable criterion for the evaluation of the varicose reservoir.

AUTHOR CONTRIBUTIONS

Conception and design: PP, SC
Analysis and interpretation: PP
Data collection: PP, BR, RB
Writing the article: PP, SC
Critical revision of the article: PP, SC
Final approval of the article: PP, SC
Statistical analysis: PP
Obtained funding: Not applicable
Overall responsibility: PP

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Submitted Sep 24, 2008; accepted Dec 23, 2008.